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Complete Specification entitled (54) "IMPROVEMENTS IN OR RELATING TO SECURITY TOKENS"

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Related Art (56)

4571/66	(402646)	54.14, 54.5, 52.6
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The following statement is a full description of this invention, including the best method of performing it known to us

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This invention is concerned with the production of bank-notes, credit cards, tickets and similar security tokens of value, and therefore likely to be forged or otherwise reproduced in a clandestine manner. It is the object of this invention to provide a distinctive form of token which will be difficult to forge or reproduce, particularly by direct photography. It is obviously desirable that a token of this nature, though difficult to forge or reproduce, should be easily recognized as genuine by unskilled persons, and it is believed that this invention makes a significant advance toward the fulfillment of this desideratum.

The wide dissemination and availability of materials and equipment for photographic reproduction, photo-etching and printing has meant that printed tokens such as bank-notes, cheques, credit cards and similar documentary securities can be forged with relative ease and little cost. Before these techniques became accepted components of printing technology, forgeries or reproductions of complex and delicate printed patterns were, of course, difficult to make. Similarly, advances in paper technology have made a wide variety of high-grade papers readily available so that the paper employed for security documents such as bank-notes has lost some of its distinctiveness.

This invention is based upon the realization that, firstly, since forgers now depend largely upon photographic processes, forgery can be rendered substantially more difficult by the use of optically-variable features which cannot be satisfactorily photographed and which have a distinctive appearance, even to

the untrained eye; and, secondly, that modern plastics technology is not readily available to would-be forgers as it represents an investment in equipment and expertise which is beyond the resources of the vast majority.

Accordingly, the present invention basically consists of a security token comprising a laminate of at least two layers of plastic sheeting intimately bonded together, at least one 'optically-variable' device enclosed between said layers, and at least one transparent window in one of the layers covering or opposite the device so that the device can be viewed there-through. Thus, from another aspect, the present invention involves the method of forming a security token by laminating at least two layers of plastic sheeting intimately together so as to enclose there-between at least one optically-variable device, a transparent window being formed in at least one of said sheets adjacent said device to allow viewing thereof. Similarly, from another aspect, the invention comprises a method for signifying the authenticity of tickets, documents notes and other security tokens by attaching thereto an optically-variable device enclosed between at least two layers of bonded plastics material, at least one of which is transparent to allow viewing of said device.

More particularly, though not essentially, a centre lamina is provided to carry the optically variable devices and identification indicia, the aforementioned layers being of transparent material and being intimately bonded to the centre lamina, one on each side thereof. Furthermore, the

centre lamina itself may be formed as a laminate constructed by intimately bonding at least one sheet of opaque plastics material to a sheet of woven or non-woven fabric formed from synthetic fibres.

As will be clear from the above, the term 'token' is used in this specification to denote a wide variety of security documents and devices such as bank-notes, credit cards, tickets, cheques etc., but it is not intended that any such list should be exhaustive or exclusive. Also, the tokens of this invention can be readily fabricated in such a way as to constitute the entire bank-note, identification card, ticket etc., since the laminated plastic sheet material can be readily printed or marked with information appropriate to the type of token concerned. On the other hand, and also as implicit in the above general statement, the tokens of this invention may constitute but a part of the document, identification card, ticket, bank-note etc.

A wide variety of synthetic plastic sheet material may be employed in practising this invention, though it is obviously necessary for some portion of the laminated sheets to be transparent as indicated above. For the sake of easy working and ready bonding, thermoplastic material is preferably employed, but this is not essential and thermosetting film-forming polymers may be used, particularly where flexibility of the token is not required. Thus, various epoxy resins may be employed in the latter situation whereas thermo-plastic sheeting produced from plastics materials such as polyacrylates, polyvinyl chlorides, cellulose acrylates, polyolefins, polyethylene terathalates, cellulose acetates and polyesters have been found to be suitable for the production of flexible

paper-like notes etc. It is also envisaged, of course, that the sheet material can be embossed, dyed, printed, texturised or otherwise treated before or after lamination; this being done on the internal or external surfaces of the laminated layers, so as to provide visual and/or tactile identification of the nature of the token, its significance or value.

The laminating techniques which can be employed to effect the present invention are many and varied and known in the art. They include: adhesive-bonding or cementing, preferably with a transparent agent; solvent-bonding, where a mist of solvent is sprayed over the surfaces to be bonded together; heat-bonding where thermoplastic sheets are subjected to a hot rolling or pressing operating; cast-lamination where one layer is cast onto the second and the second forms a substrate; or, extrusion or draw-lamination as in calandering operations known in the art. It is not necessary for the entire token to be laminated, although this is deemed to be preferable for strength and satisfactory printing, as the optically-variable devices can be enclosed in pouches affixed to a substrate. On the other hand, the optically-variable devices themselves may be incorporated in one (or both) layers of the laminated token, it not being necessary to incorporate a physically discrete device within a clearly defined pouch formed between the laminae.

As employed in the present specification, the term 'optically-variable' is used to denote any device which can readily be made to change appearance in a reversable, predictable and reproducible manner. The appearance of such devices may be altered, for example, by the application of body-heat or manual pressure, the variation of the angle

of viewing and, the lighting conditions under which viewing takes place. The type of devices envisaged by the present invention are: diffraction gratings, liquid crystals; moire patterns and similar patterns produced by cross-gratings with or without superimposed, refractive, lenticular and transparent grids, such as Fresnel lenses; spaced partially-reflective (and partially transparent) coatings yielding variable interference patterns or the like; bi-refringent or polarising layers; zone-plates and the like.

Generally, optically-active devices of this nature are readily recognized by unskilled persons and are yet extremely difficult to reproduce by photographic and printing techniques. Moreover the production of any one such device in a reproducible fashion and the incorporation of such a device in a plastic laminate as described by the present invention is likely to be beyond the resources of the great majority of would-be forgers. Where a flexible paper-like token such as a bank-note is envisaged it is of course preferable that the optically-variable devices should, themselves, be sheet-like, flexible and thin; it is also preferable for such devices to be compatible with the plastics material employed for the laminae to facilitate bonding and mitigate against reactive changes occurring with time. Of course, where a stiff card-like token is envisaged the need for a flat and flexible optically-variable device is less and thicker devices with more pronounced optical activity may be used to advantage.

According to the present invention, one preferred form of optically variable device may be a reflecting diffraction grating consisting of a metallized plastics film

embossed with a diffraction pattern. To prevent access to the embossed pattern for the purpose illicit replication, it is preferable according to the present invention to employ a layer of plastics material on each side of the metallized film which has similar solubility characteristics to that of the metal layer so that separation by preferential etching will be rendered extremely difficult. Another preferred device is a moire pattern formed by photographically reproducing fine line or dot patterns on each side of a thin film. The spacings of the dots and lines can be readily made too fine to be reproduced by printing techniques and yet the moire pattern can be displayed upon a much larger scale. Unique diffraction and moire patterns are, of course, preferred for use in the security tokens and techniques are available for producing those by computer-plotter and photo-reduction methods.

Having portrayed the broad nature of the present invention and some of the variations possible, particular embodiments will now be described by way of example and illustration only.

In the following description, reference will be made to the accompanying drawings in which:

Figure 1 is a diagrammatic representation of a security token in the form of a document seal formed in accordance with the present invention.

Figure 2 is a cross-section (not drawn to scale) of the security token of Figure 1.

Figure 3 illustrates a three-component sheet-like security token more suitable for use in share scrip or the like.

Figure 4 illustrates a five-component sheet-like token suitable for use as a bank-note.

Figure 5 is a schematic representation of a continuous production line for the bank notes shown in Figure 4.

Referring to Figures 1 and 2, the first embodiment of this invention is a simple form of security token - that is, a distinctive seal for application to documents etc. The seal 10 may be secured to the document 12 by any suitable means known in the art; for example, by a strong contact adhesive or by hot pressing. The ends of a tying ribbon 14 can be secured under the seal as is common practice.

The seal 10 consists, essentially, of a diffraction grating 16 enclosed and heat bonded between a transparent face sheet 18 and an opaque bottom sheet 20. Conveniently, in this embodiment, the latter sheets can be formed from polyvinyl chloride or polythene and can be printed on the 'inside' surfaces with appropriate indicia 22 before heat-bonding.

The diffraction grating insert 16 of the security token is preferably one which exhibits a unique and distinctive pattern which is significantly different from the effects exhibited by simple parallel lines or concentric circle gratings. Diffraction gratings of this nature can be generated by the use of a computer and a plotting table or oscilloscope tube to create a large scale pattern which is then photographically reduced, a press-die tool then being formed from the reduced photographic master by photo-etching techniques known in the art. An alternative method of forming the diffraction grating is to rule it directly on a plastic or metal surface using a directed electron beam, as in an electron microscope. In either case, it has been found preferable to use in excess of 15,000 lines to the inch in order to obtain an effective pattern.

A simple and economical method of forming the diffraction grating 16 is to hot-stamp a thin aluminium foil on to the base sheet 20 using the press dye formed as above described. The top plastic layer 18 can then be heat bonded to both the diffraction grating and the bottom layer 20. However, since it is conceivable that the plastic layers 18 and 20 could be separated to give access to the metallized layer which forms the diffraction grating, a more secure diffraction grating also formed in accordance with the present invention may be desired. This can be achieved by applying a thin layer of polymer on each side of the metal film, which polymer is designed to have similar solubility in acids and alkali as the metal film concerned. In this way, it will not be possible to separate the polymer from the metal so as to provide access to the embossed surface by selective etching of the metal itself. Furthermore, by partially cross-linking the polymer, attempts to remove the polymer from the metal by the use of solvents will result in swelling and distortion of the polymer base and the diffraction grating itself. Polymers of this nature are known to those skilled in the art, and, generally, incorporate anhydride groups; copolymers of maleic anhydride enstyrene being appropriate, for example. The addition of a small proportion of epoxide polymer to the copolymer provides a convenient way of effecting the desired cross-linking by the application of moderate heat.

Thus, referring more particularly to Figure 2, the secure diffraction grating device indicated above consists of a base polyester film 24 on to which is coated the special polymer film 26, the exposed surface of film 26 being coated with a thin aluminium layer 28 by vacuum deposition employing techniques known in the art. The metallized surface is then embossed using the press-die described above to form the diffraction grating. A second layer 30

of the special polymer is then applied in order to fill up the indentations which form the diffraction grating, layer 30 of course being transparent so as not to obscure the diffraction pattern. Both layers of the special polymer are then cross-linked by moderate heating. Finally, in order to securely bond the diffraction grating device within the laminate structure of the security token, layers of heat sealable film 32 are extrusion coated (or otherwise applied) to the exposed surfaces of the diffraction grating device. The entire device can then be securely incorporated between the upper and lower layers 18 and 20 of the token.

The second illustrative embodiment of the present invention is shown in Figure 3 and is in a form suitable for use in share scrip, security bonds and other valuable documents. Essentially, it consists of a centre lamina 34 of paper or plastics material bearing printed indicia and heat-bonded between surface films 36 and 38 of polyminylchloride. Obviously, it is intended that the top film 36 will be of transparent material, but the backing film 38 can either be transparent or opaque. Though not explicitly shown in the Figure, security devices may be incorporated within the laminate - either on the surface of the centre layer or in pockets therein - in a manner similar to that described with respect to Figure 1. In fact, the diffraction grating of the first embodiment can be incorporated as described above.

In this illustrative embodiment, it is taken that a second security feature is necessary and, by way of example, a liquid crystal device has been chosen. Liquid crystals are substances which behave mechanically as liquids and yet exhibit many of the optical properties of crystals. Moreover, the optical properties are very sensitive to variations in

temperature. The cholesteric class of liquid crystal, consisting of complex mixtures of cholesteric esters and ester carbonates, has the characteristic of changing colour with variation and temperature. Liquid crystals of this type can be obtained in sheet form and portions of the sheet - punched to particular designs - can be encapsulated in the scrip or token so that, when the insert is subjected to body heat, it will change colour in a characteristic fashion.

However, in accordance with another preferred feature of the present invention, a liquid crystal 'ink' is employed instead of the sheet. Liquid crystals reflect light of a specific wave-length depending upon their temperature, and if the light that is transmitted is absorbed by a black background, only the reflected wave-lengths are seen as a colour. It is therefore possible to print an intricate design with normal black ink on the centre laminate over a white background and apply a coating of liquid crystal; then, only the printed area will appear to change colour in response to changes in temperature.

In order to protect the liquid crystal from deterioration and dispersion during the heat of lamination, it is encapsulated by coacervation techniques known in the art before application to the laminate. This may, for example, be achieved by dissolving gum arabic and gelatin in water, adjusting the pH to about 6, adding the liquid crystals and emulsifying the mixture. Upon the lowering the pH, capsules of 25 to 100 microns in diameter are formed having a coating of gum arabic and gelatin and a core of liquid crystal; these are hardened by lowering the

temperature and adding a substance such as pentandiol. The capsules can then be incorporated in a suitable liquid carrier and sprayed or coated onto the desired area; following application, the liquid crystal ink should be dried and baked at about 100°C before lamination.

The third chosen embodiment of the invention is a laminated bank note which can readily incorporate the liquid crystal and diffraction grating optically variable devices described above. As an additional feature, the bank note may also incorporate a third optically-variable device - a moire pattern in this example. The moire pattern can be formed by photographic means using double sided film or by a double pressing operation using two press dies each similar to that described for the diffraction grating manufacture. The screens which form the moire can be of a line or dot nature but, as with the diffraction pattern, it is most preferable to design unique and spectacular patterns with the aid of a computer-driven plotter. As with the diffraction gratings, the moire patterns can be given a thin coating of a plastic material - such as PVC or polyethylene - to facilitate intimate heat bonding within the laminate.

Referring more particularly to Figure 4, the bank note of the third embodiment of this invention is a five layer laminate in which dimensional stability and tear resistance is provided by a central open weave nylon mesh 40. On each side of this two layers 42 and 44 polyethylene sheet are intimately heat bonded, each layer being opaque and prepared for printing by methods known in the art. The three component centre laminate can be punched to receive the optically variable devices and printed with the desired indicia. In the particular embodiment illustrated, the diffraction grating device is a

montage of gratings made up in the form of a portrait 46. The press die is, of course, formed with this montage so that piecing together of individual diffraction gratings is not necessary as a step of note manufacture. It will be apparent that sections of circular straight line and wavy line pattern diffraction gratings can be used for various parts of the portrait as thought appropriate. The moire device 48 must be formed with very fine line spacings if it is to be kept acceptably thin, 5,000 or even 10,000 lines to the inch are preferred. As above described, the liquid crystal device is formed by the application of liquid crystal ink over an area printed in black - in this case the coat-of-arms 50 as shown. The centre laminate together with its optically variable devices is then completely encassed by heat bonding to surface layers 52 and 54 of transparent polyethylene sheet.

It will be appreciated by those skilled in the art that the density of the various layers of the polyethylene sheet can be chosen to provide the desired degree of stiffness and 'crackle' to the bank note token and, furthermore, that surface embossing techniques are available for texturising the surface to make the notes easier to count and provide a paper-like feel. The ease with which a variable emboss can be applied can be used to provide a ready means of identification for the blind or, to create lenticular or prismoidal effects as an additional security feature.

Figure 5 illustrates one form of continuous production line envisaged by the present invention for the production of the bank note type of security token. Each layer is fed continuously from a roll and bonded by the use of hot rollers by techniques known in the art. The core fabric 56 is fed from roll 58 together with the polyethylene strips 60 and 62 (from rolls 64 and 66) to hot bonding rolls 68 and then chilling

rolls 70. However sheets 60 and 62 are first punched to receive the optically variable devices by means of punches 72 and 74. The centre laminate is then printed on each side simultaneously by printing machine 76, following which the liquid crystals are applied at an offset printing station 78. After baking at station 80, the moire and diffraction grating devices are applied from carrier strips 82 and 84 into the punched cavities provided. Finally, outer layer strips 86 and 88 are bonded to the center laminate by heated rollers 90 and the assembly is then cooled by chilling rollers 92.

It will be seen from the above description that a security token has been provided which has characteristic features that are immediately distinctive to the untrained eye and yet, are extremely difficult to reproduce and incorporate in a forger device without very substantial technical knowhow and elaborate equipment. Notwithstanding that, the production of such tokens under mass production conditions - as in a bank note printing plant - can be accomplished with reasonable economy. Scrip documents and notes produced in this way offer a durability significantly superior to that of paper.

Nevertheless, it will be appreciated by those skilled in the art that many variations and modifications are possible within the ambit of the present invention. In particular, the optically-variable security devices listed above or described in the particular embodiments are not the only devices available or convenient to incorporate. For example, a thin metal film which shows different colours in transmitted and reflected light - or which is shadowed to show a pattern in transmitted light only - is easily manufactured and yet difficult to simulate without expensive equipment and sophisticated technology.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A flexible, paper-like token, such as a bank-note or the like, comprising a laminate of at least two layers of plastic sheet material intimately bonded together and enclosing at least one optically-variable device mounted upon a centre lamina bearing indicia, at least one of said outer sheets having a transparent area so that the optically-variable device and indicia may be viewed therethrough, and wherein the centre lamina is itself a laminate of a sheet of woven or non-woven fabric formed from thermoplastic synthetic fibres intimately heat-bonded to a sheet of opaque thermoplastic material.

2. A token according to claim 1, wherein at least one optically-variable device is a thin film reflecting or transmitting reflecting grating, a liquid crystal material in thin film, a thin film moire pattern or a thin metallised plastic film having a different appearance in reflected or transmitted light.

3. A token according to any one of the preceding claims in which at least one optically-variable device comprises a thin film reflecting diffraction grating in which the reflecting surface is formed by a thin metallised layer, the device being characterised in that a layer of polymeric

material is provided in intimate contact with the metallic layer and on each side thereof, said polymeric material having similar solubility characteristics in alkali and acid solutions as the metal layer, and said polymeric material being sufficiently cross-linked to prevent ready dissolution in organic solvents.

4. A token according to any preceding claim, wherin at least one of the optically-variable devices comprises a thin layer of liquid crystal material, characterized in that the liquid crystal substance is micro-encapsulated in a transparent material capable of withstanding the heat and pressure required for lamination of the token, and characterized in that said liquid crystal material is applied over dark coloured areas formed on an inner surface of the laminate.

5. A method for producing flexible, paper-like tokens, such as bank-notes or the like, comprising the steps of continuously feeding a web of woven or non-woven fabric formed from thermoplastic synthetic fibres and a web of thermoplastic sheet material to a first laminating station, applying heat and pressure to said webs at said station to form an intimate bond therebetween so as to form a core laminate, applying to said core laminate thin film optically-variable devices and printing said core laminate continuously

on one or both sides thereof, and continuously feeding said core laminate together with at least one additional web of transparent thermoplastic sheet material to a second laminating station, and applying heat and pressure at said second laminating station to effect an intimate bond between said additional thermoplastic web and the core laminate thereby firmly securing said optically-variable devices within said laminate.

6. A flexible, paper-like token substantially as hereinbefore described with reference to any one of the accompanying drawings and incorporating any one or more of the optically-variable devices hereinbefore described.

DATED this 11th day of NOVEMBER 1977

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION and RESERVE BANK OF AUSTRALIA

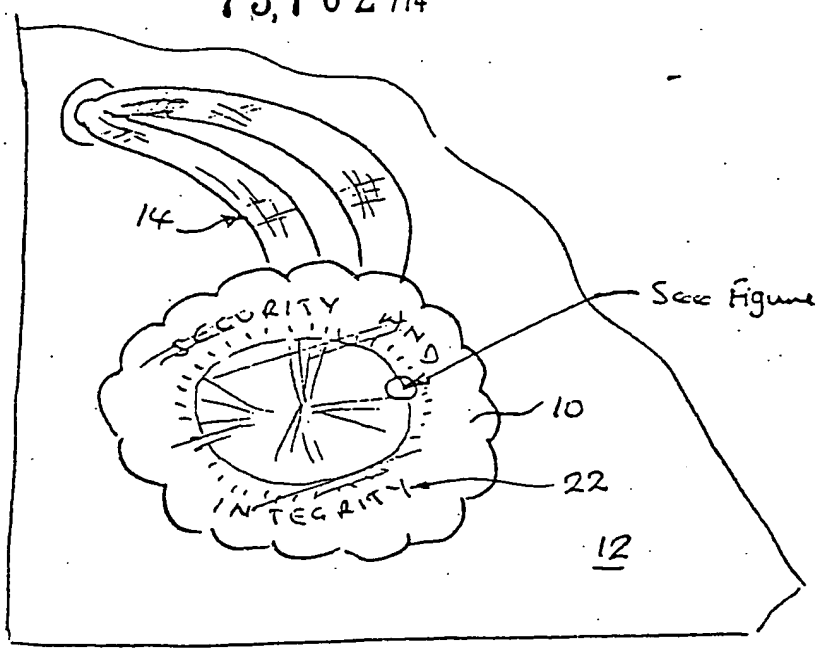

FIGURE 1

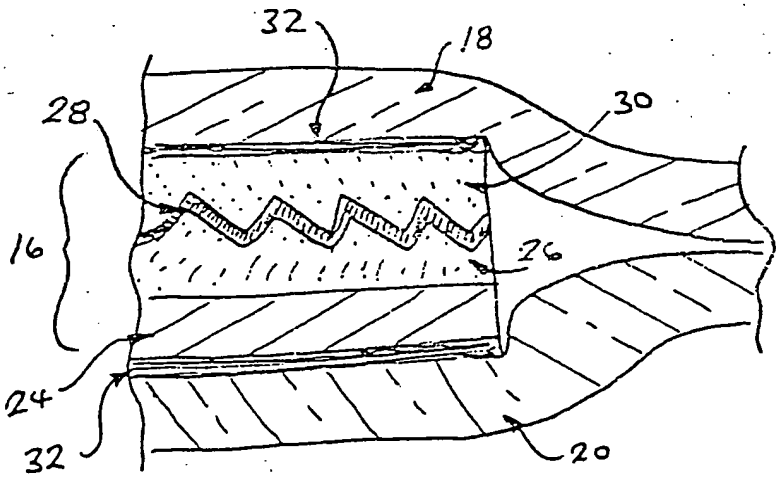

FIGURE 2

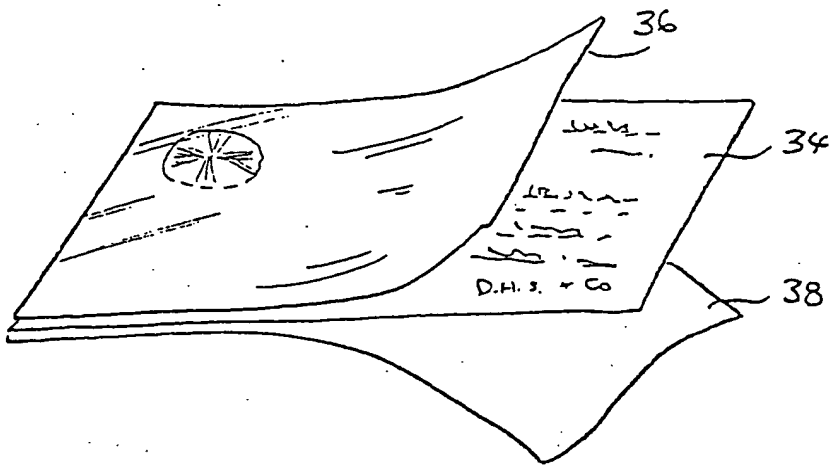

FIGURE 3

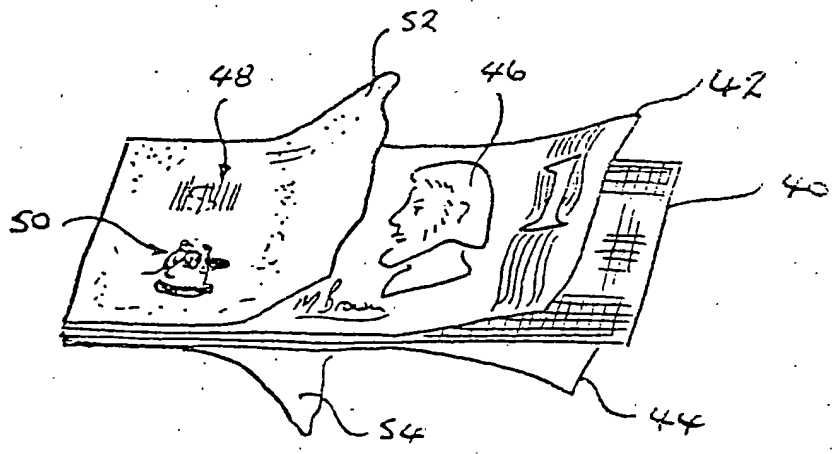

FIGURE 4

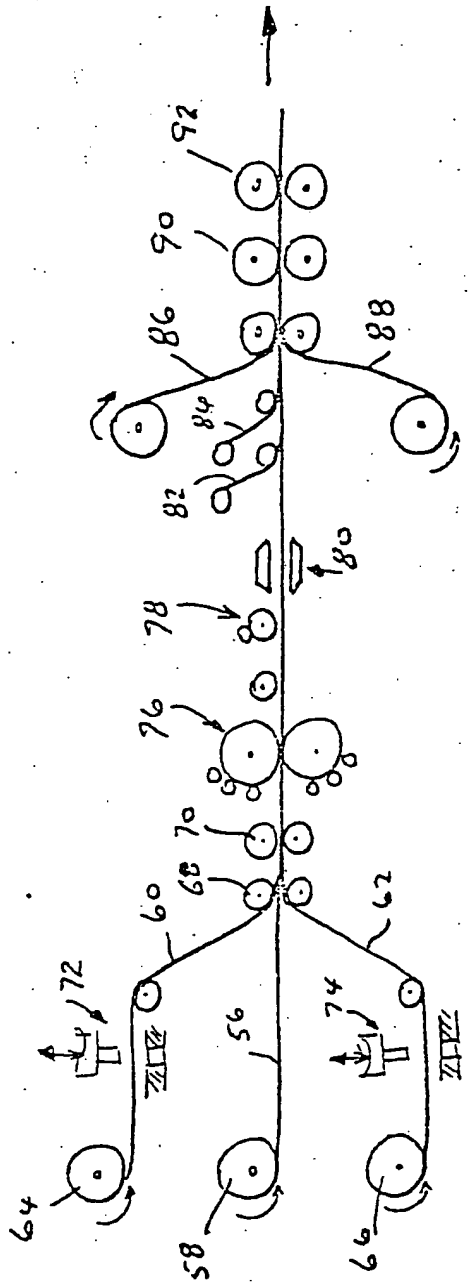

FIGURE 5